University of Victoria Engineering

Faculty of Engineering
Department of Mechanical Engineering
COURSE OUTLINE

MECH 240 Thermodynamics

Term – FALL 2016 (201609)

Instructor	**Office Hours**
Dr. Jordan Roszmann	Days: W 3:30 – 4:30
Phone: 250-721-8648	F 11:30 – 12:30
E-mail: roszmann@engr.uvic.ca	Location: EOW 503

LECTURE DATE(S)

Section: A02 /CRN13963	Days: TWF	Time: 12:30 – 13:20	Location: ECS 104

TUTORIAL SECTION

Section: T02	Days: W	Time: 14:30 – 15:20	Location: ECS 108

TA Name	**E-mail**	**Office**
Valérie Losier	vlosier@uvic.ca	ELW B260

Required Text	**Optional Text**
Title: Thermodynamics	Thermodynamics
Author: Henning Struchtrup	S. Bhattacharjee
Publisher/Year: 2014	Pearson, 2015
Reference Materials: thermofluids.net (UVic students have free access)	

COURSE OBJECTIVES:

Thermodynamics deals with the description of thermal processes and devices (heating, freezing, power plants, car motors, etc.). In this course we will study the fundamental laws and relations of thermodynamics: The conservation laws for mass, momentum and energy, the balance of entropy, and property relations.

The first law--the law of the conservation of energy--, and the second law--the law of increasing disorder--are developed for closed and open systems and then applied to analyze a broad variety of thermal systems. While the main goal is to give a thorough understanding of the fundamentals of thermodynamics, some emphasis will be put on the discussion of basic processes in energy conversion devices and their limitations due to the second law. Towards the end of the course, we shall study simple technical processes, including Otto and Diesel engines, Rankine and Brayton cycle, refrigeration and heat pump cycles.

LEARNING OUTCOMES: At the end of this course, students will be able to:

1. Determine and extract property data
   - 1.1. Distinguish between thermodynamic properties that are easy to measure (pressure, temperature, volume) and those that cannot be measured directly (energy, enthalpy, entropy);
   - 1.2. Extract relevant data from property relations and property tables.
2. Identify thermodynamic systems and describe processes therein
   - 2.1. Distinguish between open and closed systems

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2.2. Describe a wide array of thermodynamic processes as change of properties, e.g., isobaric, isochoric, isothermal, isentropic.

3. Formulate and apply the First Law of Thermodynamics to describe processes in thermodynamic systems
   3.1. Formulate the energy conservation principle in the first law of thermodynamics;
   3.2. Explain energy transfer by heat, work, mass;
   3.3. Explain conversion between different forms of energy;
   3.4. Simplify and reduce the general form of the first law into the appropriate form for any thermodynamic system and process therein.
4. Formulate and apply the Second Law of Thermodynamics to describe processes in thermodynamic systems
   4.1. Explain irreversibility in simple examples (heat transfer, friction, mixing);
   4.2. State the general form of the entropy balance;
   4.3. Simplify and reduce the general form of the 2nd law into the appropriate form for any thermodynamic system and process therein;
   4.4. Distinguish between reversible and irreversible processes.
5. Apply the first and second laws to analyze basic energy conversion systems
   5.1. Explain the limitations of energy conversion due to the 2nd law;
   5.2. Define and determine thermal efficiency and coefficient of performance;
   5.3. Analyze influence of internal and external irreversible losses on performance measures.
6. Analyze and evaluate a wide range of thermodynamic processes and cycles in closed and open systems
   6.1. Apply the first and second law to analyze basic thermodynamic processes in open and closed systems (reversible and irreversible);
   6.2. Combine results for basic processes to analyze and evaluate thermodynamic cycles.
7. Explain working principles of technical applications, assess their performance from thermodynamics laws and property relations, and use analysis to choose optimal working conditions
   7.1. Explain and carry out detailed evaluation of the processes in standard devices: Otto and Diesel engines, Rankine and Brayton cycle, refrigeration and heat pump cycles;
   7.2. Assess influence of properties (e.g., pressure and temperature range), processes (reversible/irreversible), material (e.g. limitation of maximum temperature) etc. on performance characteristics.

Weight & Dates of Assessments:	**Weight**	**Date**
Assignments:	12%	Fridays at 11:30 pm
Online Quizzes	4%	
iClicker (Response rate)	4%	
Mid-terms (3)	30%	Date: Oct 5, Nov 2, Nov 23
Final Exam	50%	Date: TBA

ASSIGNMENTS and ONLINE QUIZZES

Thermodynamics can be a confusing discipline, and it takes time to absorb the necessary concepts and vocabulary. Weekly assignments are intended to encourage you to keep up with the course material and to allow you to prepare for the exams. We will try to provide helpful feedback on the assignments as time permits, but you are expected to review the provided solutions and ensure that you are able to solve similar problems independently on the exams. You are invited to work alone or in groups on the assignments and to seek help in the tutorial sessions when you need it.

One or more online quizzes will be provided from time to time on the Course Space. These are intended to help you memorize core concepts and vocabulary. Each quiz will have a short time limit, but you may attempt it as many times as you like and your best score will be recorded. These should be attempted individually.

iCliCKERS

iClickers will be used in the lectures. Your responses will not be graded for accuracy, but your grade for the iClickers portion of the course will be based on the number of questions to which you respond. Up to three "free" responses will be added for each student on the assumption that everyone will have to miss one class. Generally, no more exceptions will be made unless a Request for Registration with a Time Conflict has been approved.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

SUPPLEMENTAL EXAMINATION

Assignment of E grade and supplemental examination for this course will be at the discretion of the Course Instructor. The rules for supplemental examinations can be found in the current Undergraduate Calendar.

GENERAL INFORMATION

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

"**Attendance**

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time….

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course." UVic Calendar, (2016) http://web.uvic.ca/calendar2016-09/undergrad/info/regulations/attendance.html

Accommodation of Religious Observance (AC1210)
http://web.uvic.ca/calendar2016-09/general/policies.html

Discrimination and Harassment Policy (GV0205)
http://web.uvic.ca/calendar2016-09/general/policies.html

Faculty of Engineering, University of Victoria
Standards for Professional Behaviour

"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty, to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals…."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities.
http://www.uvic.ca/engineering/assets/docs/professional-behaviour.pdf

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity
http://web.uvic.ca/calendar2016-09/undergrad/info/regulations/academic-integrity.html

Course Schedule

Module	Topics	Date/Week
1	Closed thermodynamic systems. Energy and entropy balances and equations of state. Internal combustion engines.	06.09 – 30.09
2	Open thermodynamic systems with ideal gases. The Brayton cycle and jet engines.	04.10 – 14.10
3	Phase changes. The Rankine cycle and vapour-compression refrigeration cycles.	18.10 – 04.11
4	Special topics: Irreversibility, regeneration, improving the basic flow cycles, equilibrium conditions	07.11 – 2.12